

# Geosyntec<sup>®</sup>

consultants

## SPECIFICATION COVER SHEET

**Client:** Gowanus Canal Remedial  
Design Group

**Project:** Gowanus Canal – 4<sup>th</sup> St  
Turning Basin Pilot Study –  
Dredging and Capping

**Project #:** HPH106A

**SPECIFICATION SECTION:**

31 51 13

**TITLE:** ANCHOR INSTALLATION

**SPECIFICATION PREPARED BY:**  
(Specification Preparer, SP)

Signature



Name

Panos Andonyadis

5/19/2017

Date

**SCOPE AND FORMAT CHECKED  
BY:**  
(Scope and Format Checker, SFC)

Signature



Name

Lauren Wellborn

5/19/2017

Date

**DETAILED REQUIREMENTS  
CHECKED BY:**  
(Detailed Requirements Checker, DRC)

Signature



Name

Darrell Nicholas

5/19/17

Date

**APPROVED BY:**  
(Specification Approver, SA)

Signature



Name

J.F. Beech

19 May 2017

Date

### Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
0	TB4 Pilots Study Design - Issued for Bid	05/19/17	PA	LSW	JFB

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## **SECTION 31 51 13**

### **ANCHOR INSTALLATION**

#### **PART 1 GENERAL**

##### **1.01 SUMMARY**

- A. The Work covered in this Section includes installation of wale beams, pre-stressed tieback anchors (tiebacks), and passive tie rods (tie rods) that may be required to brace the sheet pile walls as part of the bulkhead support system (bulkhead support) required to support the existing bulkheads in the 4<sup>th</sup> Street Turn Basin during dredging and capping. This Work may be required to address instability of existing bulkheads along the Canal, which will be determined in the field during construction, and will result in what are essentially replacement bulkheads.
- B. The Contractor shall retain a specialty contractor (Tieback Contractor) to drill, install, test, and lock-off the tiebacks. The wale beam, deadman elements, and tie rods may be installed by the Contractor.

##### **1.02 RELATED SECTIONS, PLANS, AND DOCUMENTS**

- A. Section 01 32 00 Construction Progress Documentation
- B. Section 01 33 00 Submittals
- C. Section 01 35 29 Health, Safety, and Emergency Response Requirements
- D. Section 01 71 23 Site Surveying and Grade Control
- E. Section 01 78 00 Project Closeout
- F. Section 02 51 19 Dredge Sediment and Waste Management
- G. Section 31 23 00 Upland Excavation and Fill
- H. Section 31 41 16 Sheet Pile Installation
- I. Contract Documents

##### **1.03 REFERENCES**

- A. The following standards (versions as of April 2017):
  - 1. American Institute of Steel Construction (AISC) Steel Construction Manual Code;

2. ASTM A36 Standard Specification for Carbon Structural Steel;
3. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless;
4. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products;
5. ASTM A416 Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete;
6. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes;
7. ASTM A572 Standard Specification for High-Strength Low-alloy Columbium-Vanadium Structural Steel;
8. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement;
9. ASTM A722 Standard Specification for High-Strength Steel Bars for Prestressed Concrete;
10. ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars;
11. ASTM C150 Standard Specification for Portland Cement;
12. ASTM C494 Standard Specification for Chemical Admixtures for Concrete;
13. ASTM C1017 Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete;
14. ASTM D1784 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) Compounds;
15. ASTM F667 Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings;
16. ASTM F3125 Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions;
17. American Welding Society (AWS) D1.1 Structural Welding Code – Steel;
18. AWS D1.3 Structural Welding Code – Sheet Steel; and

19. Post Tensioning Institute (PTI), 2014– Recommendations for Prestressed Rock and Soil Anchors.

#### **1.04 SUBMITTALS**

- A. The Contractor shall submit the following to the Owner's Representative in accordance with Section 01 33 00:

1. Anchorage Installation Workplan:

- a. List of materials, methods, and equipment to be used for construction and installation of the anchors and their anchorage (bond zone or deadman);
- b. List of materials, methods, and equipment to be used for handling excavation and drilling spoils produced during tieback and deadman installation, in accordance with Section 02 51 19;
- c. Certified calibration records for the stressing jack, pressure gauges, and dial gauges to be used for stressing and testing from an approved testing laboratory;
- d. Shop drawings of the deadman anchorage system (if selected) including the tie rods and deadman sheet piles. The Contractor shall include supporting design calculations for the selected tie rod diameter, and deadman position and length. Shop drawings and calculations shall be sealed by a professional engineer licensed in the State of New York;
- e. Shop drawings of a tieback anchorage system (if selected) including tiebacks and anchor heads. The Tieback Contractor shall include supporting design calculations for the selected bond zone length, grouting method, and diameter necessary to achieve target design loads and structural calculations for the selected bearing plate. Shop drawings and calculations shall be sealed by a professional engineer licensed in the State of New York;
- f. A quality control plan that meets the quality control and anchor testing requirements of this Section;
- g. Proof of qualifications in accordance with this Section;
- h. Example proof testing and performance testing logs;
- i. Neat cement grout mix design for bond zone and anchor grout; and
- j. Material certifications and mill certificates for all materials used in the construction of the tiebacks.



2. Wale Beam Installation Workplan:
  - a. List of materials, methods, and equipment to be used for construction and installation of the wale beam;
  - b. Shop drawings of wale beams and connections with supporting structural calculations. Shop drawings and calculations shall be sealed by a professional engineer licensed in the State of New York;
  - c. Fabrication and welding procedures for the wale beams;
  - d. Up-to date welder certificates for all laborers proposed to perform any welding activities; and
  - e. Material certifications and mill certificates for all materials used in the construction of the tiebacks.
3. Daily Progress Reports in accordance with Section 01 32 00.
4. Anchorage Construction Records that include:
  - a. As-built details for tieback anchorage, including wale beam location and size, tieback head location, tieback length, tieback free length, tieback inclination, and tieback bond zone length. The as-built record documents shall be prepared in accordance with Section 01 71 23 and Section 01 78 00;
  - b. Performance and Proof Testing logs for each tested tieback. Testing logs shall include measured movements for every test load increment, lock off load, observations made during testing, and any noted deficiencies; and
  - c. As-built details for deadman anchorage, including tie rod size, tier-rod length, deadman location, deadman sheet pile length, and wale beam location and size. The as-built record documents shall be prepared in accordance with Section 01 71 23 and Section 01 78 00.

## **1.05 CONSTRUCTION QUALITY CONTROL**

- A. The as-built locations, lengths, orientations, test records, and lock-off loads for each tieback installed shall be recorded.
- B. Any deviances from the approved Shop Drawings will be reported to the Owner's Representative.
- C. Dredging within the Canal cannot commence until the bulkhead support, including sheet piles and anchorage, are accepted by the Owner's Representative.

## **1.06 HEALTH AND SAFETY REQUIREMENTS**

- A. The Contractor shall comply with environmental health and safety/training requirements in accordance with the approved Health and Safety Plan and Section 01 35 29.

## **1.07 QUALIFICATIONS**

- A. The Tieback Contractor shall demonstrate experience in the installation of tiebacks over marine environments. The Tieback Contractor shall provide references for three recent projects similar in scope.
- B. All welders shall be certified by the American Welding Society (AWS).

## **PART 2 PRODUCTS**

### **2.01 MATERIAL AND EQUIPMENT**

- A. The Contractor and/or Tieback Contractor shall furnish all labor, materials, tools, and equipment necessary for completion of this Work.
- B. Steel Prestressing Bar Tendons shall be cold stressed and stress relieved threadbar tendons with minimum guaranteed ultimate tensile strength of 150 ksi and conforming to ASTM A722.
- C. Steel Prestressing Strand Tendons shall be low relaxation, 0.6-inch diameter, 7-wire tendons with guaranteed ultimate tensile strength of 270 ksi and conforming to ASTM A416.
- D. Steel Plates and Miscellaneous shapes shall be new, hot-rolled plates and shapes conforming to ASTM A36 and ASTM A572, as required by application.
- E. Cement shall be Portland cement, Type I, II or I/II meeting the specifications of ASTM C150.
- F. Water shall be potable water.
- G. All admixtures for grout shall conform to ASTM C494 and ASTM C1017 dependent on use.
- H. Neat Cement Grout shall:
  - 1. Be a stable mixture of cement, water, and admixtures for use in tieback construction;

2. Have a minimum compressive strength (ASTM C109) of 3,000 psi at time of tieback stressing and testing and 4,000 psi at 28 days;
  3. Have a maximum water to cement ratio of 0.50 by weight; and
  4. Be mixed using a high shear colloidal mixer or equivalent.
- I. All welding shall use E70XX electrodes.
- J. Deadman Steel Sheet Piles
1. All steel sheet piling shall be new and unspliced material of the type and weight shown on the Construction Drawings with  $F_y = 50$  ksi and conforming to ASTM A572 unless otherwise reviewed and accepted by the Owner's Representative.
  2. Steel sheet piles and special fabricated shapes shall be of a design that ensures continuous interlock throughout the entire length when in place.
- K. Tie rods conforming to ASTM A615, Gr. 75 ksi with double corrosion protection.
- L. Tie rod nuts and couplers shall be capable of developing 100% of the ultimate strength of the tie rods. All tie rod components shall be hot-dip galvanized (ASTM A123).
- M. Trumpets shall be fabricated from steel pipe (ASTM A53) or tubing (ASTM A500). Trumpets shall be hot-dip galvanized or coal tar epoxy coated and filled with corrosion-inhibiting compound.
- N. Corrugated sheathing or duct – An organic or deformed HDPE (ASTM F667) or PVC (ASTM D1784) tube with minimum wall thickness of 1.5 millimeters.
- O. Corrosion-inhibiting compound – An organic compound such as gel, grease or wax conforming to the requirements of PTI (2014).
- P. Structural steel plate or shapes used for the anchor head assembly and wale beam shall be coal-tar epoxy coated or hot-dipped galvanized (ASTM A123).

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. The Contractor shall confirm the existing Site conditions prior to starting Work and notify the Owner's Representative of any conditions which are not similar to those shown on the Construction Drawings.

- B. The Contractor shall verify utility locations and contact the New York City one-call system as required by law.
- C. The Contractor is responsible for the structural integrity and stability of existing structures located nearby and upland of the bulkhead support. Any damage induced or caused by implementation of the Work shall be repaired by the Contractor at no cost to the Owner. Acceptance and approval of the workplans do not indemnify the Contractor or its subcontractors from responsibility for repairing damages caused by Work related construction activities.
- D. Tie rods, deadmen sheet piles, tiebacks and wale beams shall be constructed as specified by the approved workplans and shop drawings with materials of equal or better engineering characteristics. Any design changes or field adjustments needed during construction shall be approved by the Engineer and Owner's Representative prior to executing the change in Work.
- E. The preliminary contingent bulkhead support design, including material shape and sizes, is provided in the tables below for both a deadman system and tieback anchor system. The additional anchored shoring shall be installed with the bulkhead support sheet piling shown on the Construction Drawings.

<b>Deadman System</b>	
Tie Rod Size	#18
Tie Rod Steel Gr.	75 ksi
Wale Shape	2C15×33.9
Deadman Sheet Pile	AZ19-700

<b>Tieback Anchor System</b>	
Bar Tendon Size:	#10
Bar Tendon Steel Gr.	150 ksi
Number of 7-Wire Strand Tendons	4
Wale Shape	2C15×33.9

### 3.02 TIEBACK INSTALLATION

- A. Wale beam installation shall commence upon completion of the sheet pile wall installation. The wale beams shall be constructed and installed at the elevation and orientation shown on the shop drawings.
- B. Drilling and construction of tiebacks shall commence after the wale beams have been installed and all tieback related submittals have been received and approved by the Owner's Representative.

- C. The Tieback Contractor shall install a bulkhead support anchored with Post Tensioning Institute (PTI) Class I corrosion protected tiebacks consisting of pre-stressing strand or bar tendons. Epoxy coating of prestressing steel tendons does not constitute Class I corrosion protection.
- D. Tiebacks shall be drilled to the design depths and inclinations using cased drilling methods in accordance with the schedule provided on the Construction Drawings and as proposed in the Anchor Installation Workplan. Tieback free lengths shown on the Construction Drawings represent minimums.
- E. The Tieback Contractor is responsible for providing stability for the entire length of the drill hole during all phases of the Work. External flush and open hole drilling methods are not permitted.
- F. Prior to tremie grouting, pressure grouting, and installation of a tieback, the Tieback Contractor shall flush the hole clean with water. The Tieback Contractor shall fill the casing and hole with neat cement grout using a tremie tube placed to the bottom of the drill hole prior to or after inserting the anchor and depending on whether a bar or strand tendon anchor is selected. Tieback Contractor may use either gravity grouting, pressure grouting, or post pressure grouting to develop the bond zone. The selected grouting method shall be indicated in the Tieback Anchor Installation Work Plan and in supporting design calculations.
- G. All water used during drilling and hole clean out shall be collected by the Tieback Contractor for handling and treatment by the Contractor. The Contractor shall handle, treat, and discharge the water collected during drilling and hole cleaning according to Section 44 08 40.
- H. Conduct performance or proof testing on each tieback. Testing may not commence sooner than three days after tieback installation and tremie grouting (or post-grouting if selected by the Tieback Contractor) and until neat cement grout has achieved the minimum required compressive strength (ASTM C109) of 3,000 psi for testing.
- I. After testing, lock-off, and acceptance of the tiebacks by the Owner's Representative, the Tieback Contractor shall saw-cut the tieback anchor tails. Torch-cutting of prestressing steel tendons or bars is not permitted. Tails shall be cut to the length required to fit within each permanent tieback anchor cap. The anchor cap shall be completely filled with a corrosion inhibiting compound approved by the Owner's Representative. The trumpet shall be completely filled with grout or a corrosion inhibiting compound approved by the Owner's Representative.

### **3.03 TIEBACK ANCHOR TESTING, STRESSING, AND LOCK-OFF PROCEDURES**

- A. All testing, stressing, and lock-off shall be performed in general accordance with PTI recommendations for prestressed rock and soil anchors (2014) and as specified in the

Construction Documents. No changes in the procedures shall be permitted unless approved by the Owner's Representative.

- B. Each tieback shall be tested using a hydraulic jack which has been calibrated together with production (primary) and secondary hydraulic pressure gauges within 30 days of the start of tieback testing. All jack and pressure gauge calibrations shall be traceable to the National Institute of standards and Technology (NIST) Pressure gauges shall be graduated in maximum 100 psi increments and shall be accurate to within  $\pm 1.2$  percent of full scale. Both pressure gauges shall be used for all tieback testing. The hydraulic jack cylinder shall be sized so that the maximum test load of 1.33 design load (DL) does not exceed 80 percent of the cylinder rated capacity. The Owner's Representative may request recalibration of jacks.
- C. A minimum of two tiebacks or 10 percent of the tiebacks, whichever is greater, shall be performance tested. The Owner's Representative shall select tiebacks for performance testing. All other tiebacks shall be proof tested.
- D. A performance test shall be performed by cyclically loading and unloading the tieback in accordance with the schedule below:

Cycle							
1:	AL	0.25DL					
2:	AL	0.25DL	0.50DL				
3:	AL	0.25DL	0.50DL	0.75DL			
4:	AL	0.25DL	0.50DL	0.75DL	1.00DL		
5:	AL	0.25DL	0.50DL	0.75DL	1.00DL	1.20DL	
6:	AL	0.25DL	0.50DL	0.75DL	1.00DL	1.20DL	1.33DL (Creep Test)
Lock-off	AL	0.80DL					

- E. A proof test shall be performed by loading and unloading the tieback in accordance with the schedule below:

AL	0.25DL	0.50DL	0.75DL	1.00DL	1.20DL	1.33DL (Creep Test)
AL	0.80DL					

- F. At each increment, the movement of the head of the tieback relative to an independent fixed reference shall be measured with a micrometer dial gauge capable of measuring to the nearest 0.001 inch and recorded on the testing log. The tieback contractor shall independently account for rotation of the anchor head and testing assembly due to movement of the sheet pile toward the retained ground.
- G. An alignment load (AL) of up to 10 percent of the DL shall be used. The lock-off load shall be 80% of the DL. All movement will be referenced relative to the AL as the zero reference.

- H. For the creep test at 1.33 DL, elongation readings shall be collected at 0, 1, 2, 3, 4, 5, 6, and 10 minutes. If the tieback elongation between 1 and 10 minutes exceeds 0.040 inches, hold the maximum test load for an additional 50 minutes, and readings shall be collected at 20, 30, 40, 50, and 60 minutes. After the creep test, the load shall be reduced to AL and the final residual elongation reading shall be collected. All measurements shall be documented on the testing logs for the tested tieback.
- I. Following completion of the performance/proof test, the load shall be reduced to 0.80DL and locked off. Perform a lift off load reading to establish that the specified lock off load has been reached within +/- five percent. The lock off load shall be documented on the testing logs for the tested tieback.
- J. A performance or proof tested tieback is acceptable if:
  - 1. The movement at the tieback head at the maximum test load of 1.33DL is less than or equal to 0.040 inches for the time period between 1 and 10 minutes; or the tieback movement between 6 and 60 minutes is less than or equal to 0.080 inches; and
  - 2. The elastic movement at the maximum test load of 1.33DL exceeds 80 percent of the theoretical elastic elongation of the unbonded length plus the jacking length; and
  - 3. The elastic movement at the maximum test load of 1.33DL is less than or equal to 50 percent of the theoretical elastic elongation of the bond length plus 100 percent of the free length plus the jacking length; and
  - 4. The initial lift of load reading is within +/- five percent of the designated lock off load.
- K. If (3.03-J-2) is not met on initial stressing, the tieback shall be reloaded up to two additional times from AL to 1.33DL, the elastic elongation shall be remeasured and compared against the minimum elongation criteria.
- L. If (3.03-J-4) is not met after initial lock off, the tieback shall be restressed to the correct lock off load, the anchorage shall be reset, and retest for lock off load.
- M. Any tieback which does not meet testing acceptance criteria shall be locked-off at no more than 50 percent of the load the anchor can sustain without continuous movement. The Engineer of Record will determine the usable working load of any tieback not meeting the acceptance criteria. Additional tiebacks required to carry the difference between the original design load and the reduced capacity shall be installed by the Tieback Contractor at no cost to the Owner.

### **3.04 DEADMAN ANCHORAGE INSTALLATION**

- A. The Site shall be excavated to target grades per the approved shop drawings. Excavation work shall follow Specification 31 23 00.
- B. The deadman sheet piles shall be staked out and driven following Specification 31 41 16. The alignments shall be staked by the Contractor per the approved shop drawings.
- C. Wale beam installation shall commence upon completion of the sheet pile wall and deadman sheet pile installation. The wale beams shall be constructed and installed at the elevation and orientation shown on the shop drawings.
- D. Tie rods shall be placed at the elevation, orientation, and spacing provided on the approved shop drawings. The Contractor shall take care not to damage the corrosion protection and keep the tie rods free from deleterious material. The tie rods shall be bolted to the wale beams.
- E. The Site shall be backfilled with approved material and shall follow Specification 31 23 00. The Contractor shall use low ground pressure equipment when placing and compacting material around and above the tie rods.

### **3.05 QUALITY ASSURANCE AND QUALITY CONTROL**

- A. All tieback construction work and testing shall be conducted in the presence of the Owner's Representative. The Tieback Contractor shall provide a qualified superintendent and/or field engineer who will be the point of contact for and responsible for Tieback Contractor quality control.
- B. The Tieback Contractor shall prepare detailed construction records for each tieback.
- C. The Tieback Contractor shall perform quality control testing on the neat cement grout mixture including compressive strength testing according ASTM C109 and mud balance testing.

[END OF SECTION]